The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. An electrochemical printer head for use in electrolytically depositing material onto a substrate, the electrochemical printing head comprising:

a plurality of electrodes, each electrode having a channel therethrough;

a lead connector attached to the plurality of electrodes, the lead connector having a plurality of electrical leads wherein each electrical lead is electrically connected to at least one electrode, the electrical leads extending accessibly from the printer head for connection to an electric power source; and

a high electrical resistance means for controlling the distribution of an electrolyte to the electrode channels;

a resolution-defining layer disposed below the plurality of electrodes, the resolution-defining layer having a plurality of apertures that provides an outflow path for the electrolyte from the electrode channels.

2. The electrochemical printer head of Claim 1, wherein the high electrical resistance means includes a plenum that receives electrolyte from a pressurized source of electrolyte.

3. The electrochemical printer head of Claim 2, wherein the high electrical resistance means further includes a cross-talk inhibitor made from an electrically insulating material and disposed between the plenum and the plurality of electrodes, wherein the cross-talk inhibitor has a plurality of narrow apertures therethrough that provides a flow path for the electrolyte from the plenum to the electrode channels.

4. The electrochemical printer head of Claim 3, wherein the high electrical resistance means further includes a flow distribution layer attached to the plenum, the flow distribution layer having a plurality of inlet apertures to the plenum.

5. The electrochemical printer head of Claim 2, further comprising a support layer attached to the plenum, the support layer providing mechanical support for the plurality of electrodes and the lead interconnect layer.

6. The electrochemical printer head of Claim 1, wherein the electrodes are large relative to the apertures in the resolution defining layer, and are made from a conductive material that is substantially inert in the electrolyte.

7. The electrochemical printer head of Claim 6, wherein the electrodes are made primarily of stainless steel.

8. The electrochemical printer head of Claim 1, wherein the electrochemical printer head is made from a plurality of precut layers of material that are assembled and bonded together.

9. An electrochemical printer system comprising:

a source of pressurized electrolyte;

a conductive substrate disposed in a container;

an electrochemical printing head having a plurality of electrodes, each electrode having a channel therethrough, a plurality of electrical leads wherein each electrical lead is electrically connected to at least one electrode, the electrical leads extending accessibly from the printer head for connection to an electric power source, a high electrical resistance means for controlling the distribution of the electrolyte to the electrode channels, and a resolution-defining layer disposed below the plurality of electrodes, the resolution-defining layer having a plurality of apertures that provides an outflow path for the electrolyte from the electrode channels;

a power source electrically connected to the conductive substrate and selectively connectable to each of the plurality of electrodes such that a circuit is formed between the selected electrodes, the electrolyte, the conductive substrate, and the power source; and

an actuator for moving the conductive substrate with respect to the electrochemical printing head.

10. The electrochemical printer system of Claim 9, wherein the high electrical resistance means for controlling the distribution of the electrolyte to the electrode channels includes a plenum that receives electrolyte from the source of pressurized electrolyte.

11. The electrochemical printer system of Claim 10, wherein the high electrical resistance means for controlling the distribution of electrolyte further includes a

cross-talk inhibitor made from an electrically insulating material and disposed between the plenum and the plurality of electrodes, wherein the cross-talk inhibitor has a plurality of narrow apertures therethrough that provides a flow path for the electrolyte from the plenum to the electrode channels.

12. The electrochemical printer system of Claim 11, wherein the high electrical resistance means for controlling the distribution of electrolyte further includes a flow distribution layer attached to the plenum, the flow distribution layer having a plurality of inlet apertures to the plenum.

13. The electrochemical printer system of Claim 10, further comprising a support layer attached to the plenum, the support layer providing mechanical support for the plurality of electrodes and the lead interconnect layer.

14. The electrochemical printer system of Claim 9, wherein the electrodes are large relative to the apertures in the resolution defining layer, and are made from a conductive material that is substantially inert in the electrolyte.

15. The electrochemical printer system of Claim 14, wherein the electrodes are made primarily of stainless steel.

16. The electrochemical printer system of Claim 9, wherein the electrochemical printer head is made from a plurality of precut layers of material that are assembled and bonded together.

17. A method for producing a functionally-graded material deposit comprising:

providing a conductive substrate in a container containing a liquid electrolyte;

providing an electrochemical printer head having a plurality of electrodes with a channel therethrough, the electrochemical printer head having a surface positioned in close proximity to the conductive substrate, wherein the electrochemical printer includes a plurality of flow paths therethrough, at least some of the flow paths including at least one of the electrode channels;

providing electrolyte under pressure to the electrochemical printer head such that electrolyte flows through at least some of the plurality of flow paths and is expelled toward the conductive substrate;

selectively applying an electric potential between the conductive substrate and at least one of the plurality of electrodes such that a circuit is formed between the electrode, the electrolyte, and the conductive substrate; and

varying the flow rate of the electrolyte through the electrochemical printer head and a parameter of the applied electric potential to produce a functionally graded material deposit.

18. The method of Claim 17, further comprising the step of moving the conductive substrate with respect to the printer head to produce a desired shape of functionally-graded material deposit.

19. The method of Claim 17, further comprising the step of repeatedly moving the printer head over the conductive substrate while varying the flow rate, and a parameter of the electric potential to build up a three-dimensional functionally graded material deposit.

20. The method of Claim 19, further comprising the step of varying the distance between the electrochemical printer head and the conductive substrate to accommodate the functionally graded material deposit.

21. The method of Claim 17, wherein the electrochemical printer head further comprises a plenum fluidly connected to the source of pressurized electrolyte and a cross-talk inhibition layer made from an electrically insulating material and disposed between the plenum and the plurality of electrodes, wherein the cross-talk inhibition layer has a plurality of flow channels therethrough.

22. The method of Claim 17, further comprising the step of dissolving away a sacrificial portion of the functionally graded material deposit.